Optical fibre plug connector

The present invention relates to an optical fiber plug-in connection comprising at least one pair of plug-in connectors and a coupling.

In optical transmission technology, there is often the task of accommodating a number of individual optoelectronic or optical components in a confined space and in such cases connecting their pigtails in such a way that only a small amount of additional space is required for this. An actual example is a printed circuit board with a number of optoelectronic components (for example laser diodes or photodiodes) and also passively optical fiberoptic components (for example couplers, splitters, wavelength multiplexers). A further example is an Ethernet transceiver module, in which a number of laser diode modules and receiving diode modules and also an optical multiplexer/demultiplexer pair are accommodated in a standardized compact module housing. The individual components in all these cases are provided with pigtails, which have to be connected to one another on the printed circuit board or within the module housing with a minimal space requirement. The optical fibers are in this case either only provided with a primary coating (typical diameter 245 μm) or formed as secondary coated fibers (typical diameter 900 μm). In many cases, flexibility is desired for these connections, allowing individual ones to be disconnected and reconnected, for example for measuring purposes.

An optical fiber plug-in connection of the generic type is already known from the patent WO 03/076997 A1. This plug-in connection comprises a two-part coupling and a number of plug-in connectors which can be inserted between the coupling parts. The coupling is in this case made up of an upper part and a lower part, which are aligned with respect to each other during assembly by guiding means (for example guiding pins) and are connected to each other for example by screwing. Once the two coupling parts have been connected to each other, the plug-in connectors can be respectively inserted between the coupling parts through corresponding inlet openings on the opposing longitudinal sides. The coupling parts have for this purpose inner insertion channels corresponding to the number of suitable plug-in connectors. In an insertion channel, two plug-in connectors are guided and aligned coaxially in relation to each other, so that their ferrule end faces abut resiliently within a guiding sleeve.

The plug-in connectors have in this case a securing means in the form of a frame, in which the ferrules provided with a flange (diameter 1.25 mm) are spring-mounted. Attached to the rear part of the securing means is a crimping neck, which allows cable strain-relieving elements to be anchored on the plug-in connector by means of crimping. For each plug-in connector there is an opening in the upper part of the coupling. Through this opening, a latching element arranged on the plug-in connector can be unlocked by means of a tool if the plug-in connector is to be pulled out of the insertion channel. In the case of this optical plug-in connection, the plug-in connectors can be individually accessed as desired.

A disadvantage of this optical fiber plug-in connection is that the coupling comprises an upper part and a lower part and a number of fastening parts, which are necessary for connecting and putting together the upper part and lower part. For instance, the upper part and lower part must be aligned exactly with respect to each other and connected to each other by means of a number of screw connections. The production of the parts and their assembly involve considerable effort. Likewise, the plug-in connector is provided with a series of components, which have to be individually created for the plug-in connector system described. For instance, the possibility of crimping strain-relieving elements on the connector parts must be provided.

It is therefore the object of the present invention to provide a compact, space-saving optical fiber plug-in connection which comprises only few components.

The optical fiber plug-in connection according to the invention has in particular the advantage that the coupling comprises only a single component and can consequently be produced and assembled in a simple manner. Putting together the optical fiber plug-in connection no longer involves complex assembly operations. The optical properties of the connections (attenuation, return loss) and also their climatic and mechanical stability (vibration, impact loading) correspond to those of a high-grade optical plug-in connection, as required for the corresponding application in transmission technology.

Further advantageous refinements of the invention emerge from the subclaims.

For instance, the sleeve receptacles and receptacles for the plug-in connectors are integrated within the coupling and constructed in a simple form in production engineering terms.

The plug-in connectors of a pair are aligned coaxially with respect to each other and detachably fixed within the coupling by means of a latching device, so that access to individual pairs of fibers of those connected is possible according to choice.

According to a further subclaim, there is the advantage that each plug-in connector has an arresting part with a T-shaped attachment, which engages in the guiding groove of the coupling. As a result, the plug-in connector is mounted and guided in the coupling and the ferrules are mounted and guided in the guiding sleeve in a very simple way, the two ferrule end faces of a pair of plug-in connectors abutting resiliently on account of the compression springs within the guiding sleeve.

The invention is explained in more detail below on the basis of an exemplary embodiment represented in the drawings, in which:

Figure 1 shows a perspective view of an optical fiber plug-in connection with a coupling and eight pairs of plug-in connectors;

Figure 2 shows a perspective view of a plug-in connector.

In Figure 1, an optical fiber plug-in connection 1 is shown as a multiple optical fiber plug-in connection for eight pairs of plug-in connectors 3. The optical fiber plug-in connection 1 comprises a coupling 2 with plug-in connectors 3 arranged therein. The coupling 2 comprises a base plate 23 and two side walls 24, so that two receptacles 20, 21 lying opposite each other are formed for the plug-in connectors 3. Additionally provided, centrally between the receptacles 20, 21 is a sleeve receptacle 19, which in Figure 1 is represented partly in a broken-open view to illustrate the position and arrangement of the guiding sleeves 5 inserted into the sleeve receptacle 19. The sleeve receptacle 19 additionally has four through-bores 25, so that either a number of couplings 2 can be screwed to one another, lying one on top of the other, or a single coupling 2 can be screwed onto a plate (not represented).

Each plug-in connector 3, which is also shown in Figure 2, comprises a ferrule 4, a ferrule flange 7 and an arresting part 10. As explained in more detail later, the end of the optical fiber 18 is cemented into the ferrule 4, with primary or secondary coated optical fibers being used in particular.

In the coupling 2, the plug-in connectors 3 are respectively connected to one another in pairs. Each plug-in connector 3 of a pair is in this case positioned into the separate first and second receptacles 20, 21. The coupling 2, acting together with the plug-in connectors 3, has the task of aligning the ferrules 4 of a pair of plug-in connectors 3 with respect to each other and pressing them together with the required compression force. For the necessary compression force - as shown in Figure 2 - the plug-in connector 3 is provided with a compression spring 17, which is pushed onto the ferrule extension 9. (The permissible tolerance range for the compression force in the case of all standardized optical plug-in connectors with cylindrical zirconium ferrules is fixed and is instrumental in reliably maintaining the optical data of the plug-in connection). Serving for the alignment of the ferrules 4 are the guiding sleeves 5, which are customary in the case of optical fiber plug-in connectors with a cylindrical ferrule.

The guiding sleeves 5 are accommodated in the central region of the coupling 2, in the sleeve receptacle 19. For this purpose, the sleeve receptacle 19 is provided with a series of equidistant bores 6, in which the guiding sleeves 5 are accommodated in a protected manner in the inserted state of the plug-in connectors 3 (with lateral play in relation to the walls of the bores).

Figure 2 shows an optical fiber 18 prepared for use with the optical fiber plug-in connection and fabricated with a plug-in connector 3. The end of the optical fiber 18 freed of the coating is cemented in the ferrule 4 provided with a ferrule flange 7, in a way corresponding to the customary technique used when fabricating optical fiber connectors. The ferrule flange 7 is formed in the front region as a square 8 and in the rear part as a cylindrical ferrule extension 9, which serves as a guide for the compression spring 17 and receives in its interior the adhesive that is used to ensure adequate strain relief of the optical fiber 18 provided with a primary or secondary coating. The flanged ferrule (diameter 1.25 mm) is the same design as that used in the case of an optical fiber connector of the LC type.

However, in principle a different 1.25 mm ferrule provided with a flange, of the SFF (Small Form Factor) connector type or some other type (for example MU or LX.5), may also be used. The ferrule end face 11 is provided during fabrication with a suitable polish (for example PC or UPC), as also applied in the fabrication of a customary connector. Furthermore, during fabrication, the compression spring 17 and the arresting part 10 are pushed onto the optical fiber 18 before the end of the optical fiber 18 is cemented into the ferrule 4.

To establish a connection between two plug-in connectors 3, firstly a guiding sleeve 5 is pushed onto one of the ferrules 4 of a pair of plug-in connectors 3. The ferrule 4 with the guiding sleeve 5 is then introduced into a free bore 6 of the sleeve receptacle 19 of the coupling 2, with the plug-in connector being placed into the first receptacle 20. After compressing the compression spring 17 by a defined amount, the T-shaped attachment 12 formed at the bottom of the arresting part 10 can be introduced into the correspondingly shaped guiding groove 12 in the coupling 1 and arrested there by pushing it back in the axial direction. The compression spring 17 respectively strikes against the square 8 and the arresting part 10. Once the plug-in connector 3 of the other side has been placed into the second receptacle 21 and the flanged ferrule 4 of the other side introduced into the bore 6 and arrested in the same way, the two compression springs 17 provide the correct compression force between the two ferrules 4 of a pair of plug-in connectors 3. The two ferrule end faces 11 then abut resiliently under pressure.

To disconnect a connection between two plug-in connectors 3, the tool 14 represented in Figure 1 is used, with which the arresting part 10 is released from the guiding groove 13 by pressure in the axial direction against the spring tension. For this purpose, the tool 14 is provided in the front region with two lugs 15, which engage in corresponding clearances 16 in the arresting parts 10.

Apart from the ferrules 4 with PC or UPC polish, the optical fiber plug-in connection may also be used for the connection of obliquely polished APC ferrules. For this purpose, a step 22 is formed on both sides of the sleeve receptacle 19. This step 22 provides the required twist prevention of the ferrules 4, since the square 8 of the ferrule flange 7 rests on this step 22 in

the inserted state of the plug-in connector 3, and the plug-in connector 3 consequently cannot twist.

For a connection to be established more efficiently, it is also conceivable to combine a group (for example four) of plug-in connectors 3 that are adjacent in the optical fiber plug-in connection 1 by means of the arresting parts 10 to form a single part and in this way collectively establish the connection for the group of plug-in connectors concerned in a single operation.

Furthermore, it is possible in principle to dispense with the compression springs 17 on one side of the optical fiber plug-in connection 1, since the required compression force between the ferrules 4 can also be ensured with in each case only one compression spring 17 per connected pair of plug-in connectors. The flanged ferrules 4 are then arrested on one side of the optical fiber plug-in connection 1 by suitable means without springing, in such a way that they cannot move back in the axial direction when the ferrule 4 is introduced on the other side. For this purpose, arresting parts 10 similar to those on the sprung other side can be used.

In principle, the construction of the optical fiber plug-in connection 1 is possible in its smallest configuration in such a way that, by contrast with the exemplary embodiment represented, only a single pair of plug-in connectors 3 is inserted into the coupling 2. Any desired multiples of pairs of plug-in connectors 3 are conceivable, with the coupling 2 being formed in a way corresponding to the number of pairs of plug-in connectors 3.

LIST OF DESIGNATIONS

1	optical fiber plug-in connection
2	coupling
3	plug-in connector
4	ferrule
5	guiding sleeve
6	bore
7	ferrule flange
8	square
9	ferrule extension
10	arresting part
11	ferrule end face
12	T-shaped attachment
13	guiding groove
14	tool
15	lugs
16	clearances
17	compression spring
18	optical fiber
19	sleeve receptacle
20, 21	receptacle for plug-in connector
22	step
23	base plate
24	side walls
25	through-bores